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ABSTRACT

Focusing on three education levels (precollegiate, collegiate, and the graduate and professional levels), the recommendations are based both on "what appears to work" and on "what appears to be worth trying". A fourth group of recommendations is aimed at responsible governmental agencies and professional and other organizations. The recommendations include: that an assessment of science and mathematics education in schools serving Indian students be conducted; essential characteristics of successful approaches to Indian education in these areas be integrated; bilingual techniques must be used where language retention is maximal, especially on the elementary levels; an ethnoscientific approach to teaching high school science be used; concentrated attention should be given to math deficiencies; special programs must be established in fields where they do not now exist, i.e., physical sciences, mathematics, and resources development; greater efforts should be directed at identifying and recruiting Indian students for participation in special programs for minorities in scientific and technical fields; the developing Graduate Centers for Minority Education in Science and Engineering must make sure that they include within their plans, programs and staffing for the special needs of Indian students; adequate financial aid must be available to graduate students; some graduate and professional programs should conscientiously include a multi-cultural focus, specifically an Indian focus, in their training. (NQ)

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# RECOMMENDATIONS FOR THE IMPROVEMENT OF SCIENCE AND MATHEMATICS EDUCATION FOR AMERICAN INDIANS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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# Recommendations for the Improvement of Science and Mathematics Education for American Indians

## INTRODUCTION TO THE PROBLEM

Of all minority groups in the United States, American Indians are the most poorly represented in the natural sciences, the health sciences and mathematics, yet native peoples are the most needful of any minority group of improvement in the status of their health, education, and social welfare. Indian health needs are generally well-known, as are the grim facts of Indian underachievement in education, but other needs beyond basic health care delivery and education exist in plenty. The necessity for more Indian professionals in all fields and for economic development throughout the native world tie the major areas of concern together. Most land-based Indians are in a serious struggle for the retention and development of the land they own, and in that struggle lies a potential for economic development which can change health care and education patterns for the better. Thus, native engineers, geologists, hydrologists, resource planners and managers, conservationists, foresters, agronomists, aquaculture specialists, chemists, geneticists, animal husbandry specialists, botanists--all are needed for resource development, management, and planning on Indian lands. And Indian teachers and programs in these fields are needed to raise the general educational level of Native people, as well as to provide training for meaningful career options for all Indians, rural, urban, land-based and not.

A majority of Indian college students choose the social sciences or education as major fields.[1] A large percentage of those in the social sciences are directed toward the applied "helping" fields like social work or law. Business majors are on the rise, but areas like the humanities and applied arts remain as low choice areas unless combined with an education major. The combination of a social science major with Native American Studies is a common route where such programs exist. The science or mathematics majors are rare except in the selective colleges where the Indian science students seem to enter preprofessional tracks like pre-medical or pre-dental.[2] Since elementary education is more often chosen by Indian students than secondary education, few develop specialty areas like science and mathematics. While there are increasing numbers of undergraduate students entering the biological and health sciences, there are still very few mathematics, physics, physical chemistry, computer science or geology majors appearing in the small pool of those undertaking scientific and technical education.

Awareness of these enrollment patterns and of the need for trained professionals in the native communities has led to the establishment of special programs to attract Indian students to science and technology. A recent AAAS publication, An Inventory of Programs in Science for Minority Students, 1960-1975, describes these programs and places them in the perspective of nationwide efforts for minorities in these fields.[3] There are programs in engineering, medical sciences, resource development,

and career counseling. Some are university level degree courses; some are summer enrichment programs; some are adult training projects. A few are sponsored by the universities (often with federal or other outside financial assistance), others by industry, tribes, state governments and urban Indian councils.

These programs have begun to address the complex problems of changing the pattern of Indian underrepresentation in the sciences and technical fields. They account for most of the current students of science. Most of these programs, however, are in engineering and the biomedical sciences. At present there are no identified special programs for American Indians in physics, chemistry, computer science, or the geological sciences, though a proposal for a physics program is under development at a major state university.

These programs are generally small in enrollments, and, in any case, not impacted on by the number of Indian professionals which also remains small. Among those who have identified themselves as holding a terminal degree in their field are less than one hundred in medicine, two hundred in engineering, five hundred in nursing, and perhaps fifty in the biological and physical sciences.[4] The number in allied health fields is not yet determined, but is probably under two hundred.

The continuing nature of the problem is underscored by the low numbers of science teachers and professors who are themselves Indian[5] and by the low number of current science students who intend to teach at any level.

## AAAS PROJECT ON NATIVE AMERICANS IN SCIENCE

Having been made aware of the general nature of these problems by its Committee on Opportunities in Science and in particular by its advisory Panel of Native American scientists, the American Association for the Advancement of Science (AAAS) made the improvement of science education for Native Americans a priority effort.[6] In addition, the governing bodies of the Association recognized the contributions of Native Americans to science, engineering and medicine and urged the serious scholarly study of those accomplishments.[7]

With support from the Educational Foundation of America, the AAAS was able in December 1975 to establish the Project on Native Americans in Science and to provide it with full-time professional staff. As director of the project, Dr. Rayna Green's initial responsibilities were several: to conduct a pilot study that would elucidate the barriers obstructing the entry of American Indians into science; to work with other Indian scientists, educators and organizations in exploring the possibility of cooperating with them, especially on the improvement of science and mathematics education and on the development of Native American faculty in the predominantly Indian institutions; and to collect and share with others the existing information on science education for Indian students.

At the heart of these activities lies the report on The Barriers Obstructing the Entry of American Indian Students Into the Natural Sciences. The intensive field interviews required for that study, two meetings of native advisors at the AAAS in Washington in 1976, and many other consultations with individuals and organizations, have led to the formulation of the recommendations in this report. Some fo them are necessarily a call for further, more detailed assessment and planning, but we believe that the needs and the general outline of the remedies are clear. So also, in some instances, are the responsibilities clear. The following recommendations will serve as the basis for continuing discussion across the country of the practical need to improve science and mathematics education for Indian students, a discussion stimulated this year by the initial inquiries we have made.

## RECOMMENDATIONS

The following recommendations have been grouped and focused at three different levels of education. A fourth group, more general, more policy-oriented and more national in scope, is aimed at responsible governmental agencies and professional and other organizations. In the discussion of educational needs, we have addressed ourselves both to specific types of programs as well as to characteristics we believe generally useful. The recommendations are based both on what appears to work and on what appears to be worth trying. And much of what is recommended in addition is based on extrapolation from what students say works for them and from what program staff say has the most success. The various indications posited in the synopsis of findings in The Barriers... report have given the clue to the kinds of programmatic suggestions and statements of need given below, thus, much of the supporting evidence for each statement is to be found in that report. Examples of types of programs, program components or outreach are given here as example and as a stimulus for discussion.

## PRECOLLEGIATE PROGRAM NEEDS

Most Indian students never get to college, so education, recruitment and counseling needs must be met at the precollegiate level if we seek to increase the pool of Indian students from which scientific and technical workers can be drawn. The Inventory... shows only twenty-three programs in science specifically targeted for native students and eighteen of them are at the collegiate or professional level. There are undoubtedly many more worthwhile efforts by individual schools and teachers of which we are not yet aware, but that does not contradict the general finding that the major programs are found where the outside money, mostly federal, is available.

Two themes have run so consistently through every meeting, consultation and interview that they demand attention in any set of recommendations. First, the felt and stated need among Indian scientists and educators is for applied science, for trained personnel who can assist Indian communities in solving real problems. Second, we hear reiterated the need for counseling,

not only for students, but also for their teachers, counselors and families, on the utility of science and the employment opportunities in scientific and technical fields.

The school systems themselves have primary responsibility in the areas discussed, but they are entitled to advice and assistance from public and private funding agencies and appropriate professional organizations.

Recommendations

1) An assessment of science and mathematics education in schools serving Indian students. Such an assessment should catalogue and evaluate offerings and productivity in predominantly Indian schools. They would be evaluated against the needs of the communities for informed citizenry and professional personnel. The assessment should take place in the regional areas administered by the Bureau of Indian Affairs (BIA), in tribally and other Indian-controlled school systems, and in other rural and urban systems heavily impacted by native populations. The Navajo science education assessment now being organized is an example of the necessary initiative. The BIA, tribes, and school boards of these systems bear the responsibility in this area, but they clearly should have the encouragement and support of federal programs that support education and the cooperation and advice of the professional associations with experience and interest in science and mathematics education, e.g., American Association for the Advancement of Science, National Council of Teachers of Mathematics, National Science Teachers Association, American Association of Physics Teachers, National Association of Biology Teachers, et al.

2) Integration of essential characteristics of successful approaches to Indian education in science and mathematics. Even while the assessments are going forward, schools can begin to adapt to their own varying circumstances the approaches that give greatest promise of success:

A. Courses organized around the science of everyday experience in primary school introductions to science and on the secondary level as elective courses for science and non-science majors. Courses should particularly focus on the environmental aspects of the daily life of the particular group of students, with special attention paid to the historical and contemporary living situations of Indian peoples. (For example, whole courses could focus around the ecology of a tribal reservation area or on an urban environment, and parts of courses could be devoted to nutrition, to natural resource development and its effects on the natural and human environments, or to the technologies used to effect resource development.) Outreach components of such courses could be developed which would seek to involve members of the community in the learning process, and these would most likely be successful where specific decisions about scientific and technical matters (i.e., strip mining on Indian land) make an an increased science literacy more important. This approach can be combined with standard programs emphasizing hands-on laboratory, experienced-based instruction, such

Science Curriculum Improvement Study (SCIS), Science--A Process Approach (SAPA), Elementary Science Study (ESS), etc. On the secondary level it can be realized in work-study situations.

B. Bilingual science and math instruction. Bilingual techniques must be used where language retention is maximal, particularly on the elementary levels. Bilingual science and math instruction depends on the production of curriculum and native language scientific and technical dictionaries, and will have to be produced through the cooperation of scholars and members of the community. The bilingual education must not, however, be just a matter of translation, but one which involves genuine respect for the Indian culture and which takes into account the learner characteristics of native students. Teacher-training institutions must give attention, in both pre-service and in-service training, to attitudinal as well as linguistic matters.

C. Concentrated attention to math deficiencies. Mathematics competence has been identified by everyone consulted as absolutely essential, and at present, constitutes a primary barrier to general and science-specific education. Two approaches will be helpful. First, the techniques developed to overcome "math anxiety"[8] should be explored for their applicability with Indian students, both male and female. They could be undertaken as part of individualized instruction or tutoring, or made part of regular mathematics courses. Second, individualized mathematics instruction and/or tutoring should be tried in a number of different settings. They may be particularly useful for beginning courses in general mathematics, algebra and geometry, but can later be adapted to trigonometry, calculus, etc. They may be especially useful when combined with tutoring and particularly helpful when students act as tutors. Standardized programs or programs developed for a particular situation can be used with expectations for improvement.

D. Incorporation of ethnoscience. The outstanding experience of some teachers of the Navajo, using an ethnoscientific approach to teaching high school science,[9] recommends this approach to teaching in other tribal areas. Where traditional modes of Indian scientific inquiry are still functional and operative and where native specialists (herbalists, astronomers, healers, diagnosticians, etc.) can take part in the sharing of knowledge with children, this approach should work well. Programs should draw heavily on the knowledge of members of the community when their knowledge can be shared (for example, when it is not specialized knowledge meant only for clan initiates or healers-in-training) and on the "discovery" skills of the students themselves. Utilization of these materials and persons should not be restricted only to all Indian schools, for they can be equally instructive to non-Indians and can contribute also to their respect for Indian traditions. Such programs would require specialized teacher training both in ethnoscience content and methodology. In addition, the much desired tribal and regional adaptations of general methodologies would have the added benefit of involving the local community in preparation of materials and activities for the courses, and raising community appreciation of the need for science and math instruction.

E. Taking advantage of working experience. Among college students committed to scientific and technical careers, practical experience, usually as a paid worker, was often the basis of a career decision (see The Barriers...). For most students that experience was post-secondary. Opportunity should be taken also by secondary school science educators to provide meaningful practical exposure to the scientific and technical world of work.

F. Academic and career counseling. According to The Barriers... study, most Indian college students, in or out of science, feel that they have been their own counselors. Better career information, associated especially with academic counseling and the course selection process, could only be a plus. These should be separated from personal and especially disciplinary counseling and preferably vested in an Indian counselor or other person with whom native students can readily relate. Career counseling could usefully be combined with work-study programs developed in the community and summer career health/science enrichment programs available to students through universities or efforts funded by businesses and foundations.

G. Identification-recruitment programs. Secondary schools should accept responsibility for locating and placing Indian students in post-secondary programs in cooperation with state universities and community colleges and special science and technical programs in those institutions; tribal career development staff; Indian professional associations; parent-school committees; federal and Indian-controlled institutions; federal programs and agencies (Upward Bound, the Armed Services, Vista, etc.); and teaching, counseling and extracurricular personnel in the schools.

## NEEDS AT THE COLLEGIATE LEVEL: PROFESSIONAL AND PREPROFESSIONAL TRAINING

Two valid generalizations from AAAS findings have special significance for collegiate level programs to recruit Native Americans to scientific and technical fields (see the Inventory... and The Barriers...). First, it is absolutely clear, if ever there were a doubt, that special programs, funded and organized to attract and support Indians into non-traditional fields, do work and are responsible for a large proportion of Indian enrollments in health and engineering. Second, for the science students interviewed in The Barriers... study, on-the-job experience--in the army, in hospitals, etc.--seemed to be the single most important career determinant. Efforts to increase the number of Indians entering non-traditional fields should capitalize on this knowledge.

The recommendations in this section are aimed toward the federal agencies that have, or could, support special programs and toward the higher education institutions that have large concentrations of Indian students and who must take on continuing responsibility for institutionalizing and supporting special programs. Among those, the ones that are predominantly Indian in their enrollment have special needs and mission. The recommendations should be heeded also by appropriate professional associations.

Recommendations

1) Existing special programs in the health sciences and engineering deserve continued support. These programs have amply illustrated that it is possible to attract students to non-traditional careers even in the absence of any role models or previous acquaintance with the profession, providing the programs are well designed, staffed and funded. They must not be allowed to die as so many special programs for minorities have, just when they are beginning to achieve their promise (see the Inventory...). This means that (1) federal agencies, private foundations and corporations must maintain an adequate level of support and (2) the higher education institutions must themselves assume responsibility for continuing the experience their staffs have acquired.

2) Special programs must be established in fields where they do not now exist--in the physical sciences, in mathematics, in rescurces development. The operative programs are almost all in the health sciences and engineering, where they have been stimulated and supported by the National Institutes of Health (NIH), and by selected private foundations and corporations. Other federal agencies that have responsibility in these areas (National Science Foundation (NSF), Energy Research and Development Administration (ERDA), U.S. Department of Agriculture (USDA), Environmental Protection Agency (EPA), et al.) must increase their roles in their fields. Private foundations and corporations in related industries must do their part. Professional asscciations must be advocates, advisors and assistants.

Into these programs must be integrated the kinds of techniques, discussed on the precollegiate level above, that show the greatest promise, most importantly meaningful work-study arrangements, culturally sensitive instruction and materials, mathematics anxiety therapy, and hands-on and individualized instruction. Cooperative, intern, and teaching assistant components should be structured into programs wherever possible, and they should attempt to develop affiliation on a regular basis with business, inudstry, government, state, local agency projects in the field to achieve maximum student identification with career options and work in the "real world." Like most successful biomedical sciences programs, mathematics and physical sciences programs should take a team-based approach along with an applied focus. In the physical sciences programs, mathematics instruction should be adapted for use in the specific field and applied to real rather than abstract problems ordinarily encountered in the field wherever possible. Physical sciences programs as well should be directed toward problem-solving, with heavy emphasis on contemporary Indian educational and resource and economic development needs. In natural resources and conservation fields, the most needed and least represented in program development, new programs should be based on Indian needs and problem-solving in applied situations.

3) Greater efforts should be directed at identifying and recruiting Indian students for participation in special programs for minorities in scientific and technical fields. Post high school certificate and precollegiate high school programs should be undertaken as a joint effort of post-secondary institutions with special programs and local secondary institutions which serve native populations. The target groups are an

Indian adult population with a gap between high school certification and proposed entry into collegiate work and a high school student population with a demonstrated readiness for advanced work.

4) Teacher-training and counselor-training institutions must increase their production of graduates and in-service trainees who can tackle science and math inadequacies of Indian students at the precollegiate level. Teacher and counselor training programs involved in preparation and in-service training programs of personnel for Indian communities must increase their emphasis on the utility and importance of math and science, and must develop knowledge and cultural sensitivity in trainees that will make them effective helpers in Native American communities. Training should take the form of a special area of focus in the general education degree or be a special program especially for minority/Indian students. Programs should be directed also to the "science literacy" of the community as well as toward general teacher education. Higher education institutions must be joined in this task by relevant professional associations (National Science Teachers Association (NSTA), American Personnel and Guidance Association (APGA), etc.).

5) The role of the predominantly Indian institutions in all of these endeavors must be sharpened and enlarged. This group includes three federal institutions, one religious-based school, and thirty-four tribal or local institutions. Most are new, are community or other two year colleges. Only a few offer anything in the way of science or demonstrate any special awareness of needs in the science and mathematics area. Others recognize the needs, but because of budgetary and personnel constraints are unable to implement a program. The Indian education associations and the scientific professional societies should play a role here in advocating the development of relevant math and science programs and in facilitating the meeting and planning necessary to enhancing their role and effectiveness.

## NEEDS AT THE GRADUATE AND PROFESSIONAL LEVEL

Minority scientists and educators know from experience and from other explorations of the problem[10] that the minority science students, including Indians, who enroll in graduate programs are, by definition, a specially self-selected motivated and able lot. In short, to have overcome so many barriers and to have gotten that far, they necessarily possess all of the usual attributes of academic success plus some others. At this level they may well need, however, four kinds of help: (1) financial support that comes from minimum economic guarantees, (2) psychological support from a sufficient number of fellow Indian students, and staff or community contacts to offset the feelings of isolation experienced by "the special few"; (3) non-patronizing remedial assistance if it is necessary and asked for; and sometimes, (4) special additional course content that makes the professional or graduate training pertinent to community needs.

### Recommendations

1) Graduate and professional institutions seeking to enroll Indian students must meet some minimal requirements. They must recruit in sufficient numbers to allow the formation of a community of Indian students

large enough to avoid isolation and alienation and to provide a mutually supportive atmosphere. The institutions must make every effort to have on their faculties and/or staff advisors who are themselves Indians. They must look carefully at student financial needs, including family obligations, and try to put together available funds into an adequate financial package. They must review academic regulations and requirements and make sure they admit late starters and permit dropping in and out as financial and family obligations may require.

2) The developing Graduate Centers for Minority Education in Science and Engineering must make sure that they include within their plans, programs and staffing the special needs of Indian students. There is a need for special programs at the graduate level just as at the undergraduate level, but not all institutions can or need to develop them. The Minority Centers envisioned in the National Science Foundation Fiscal Year 77 Authorization Act are a good place to begin. In considering both guidelines for the program and subsequent grant applications, the needs of Indians must be made explicit. All too often those needs have been lost in "minority" programs (see the Inventory...).

3) Adequate financial aid must be available to graduate students. Existing federal educational aid programs (BIA) and other private ones udnerscore the great need of support of undergraduate students. If however, we seek to train significant members of Native American graduates in specialized fields, adequate financial support at the graduate level could be a major incentive. Indian communities and organizations must help funding agencies to identify areas and kinds of needs. Professional associations and graduate departments are perhaps best able to counsel on the fitness of existing programs for Native American needs. All fellowship programs must be reviewed for provisions which would inhibit Indians returning to school after employment, marriage and children, military service, etc. for these are the characteristics of many Indians currently in these programs (see The Barriers...). In funded programs which seek to impact on the long-range needs of Indian peoples, funding priority should be given to those students preparing to work in Indian institutions or to train other Indians, or financial incentives in fellowship receipt or loan repayment should be tied to a period of service in or for an Indian community.

4) Some graduate and professional programs should conscientiously include a multi-cultural focus, specifically an Indian focus in their training. All professionals who are intending to work with native communities--physicians, nurses, and other health professionals, engineers, natural resource specialists, agricultural extension workers, teachers, architects, etc.--whether they are Indians or not, need more information and understanding of cultural variations, traditions, and values than is normally a part of professional training. The successful transfer of technology and knowledge must be governed by an understanding of existing cultural values and indigenous scientific and technical traditions. In this area, where scholarly information must impinge on curriculum development and course content, the professional associations are the group to take responsibility.

5) Post-baccalaureate programs for Indian students should be developed by graduate institutions. These should be aimed at removing the deficiencies of an inadequate or other-field directed baccalaureate degree and preparing the student for graduate or professional training in science and other technical fields.

## NEEDS TO BE ADDRESSED OUTSIDE THE EDUCATIONAL INSTITUTIONS

There are a number of needs--for information, coordination and cooperation--that are best addressed by organizations of Indian educators and scientists working with pertinent science and educational professional associations. There are, as well, major policy issues related to the increased participation of Indians in scientific, technical and biomedical fields where cooperative and advocacy roles with state and federal agencies must be undertaken by these various organizations.

### Recommendations

1) A clearinghouse for information on math and science needs and programs in the Indian communities should be established and maintained. The exchange of information and contacts thereby established will constitute a network that can help to develop ties among Indian scientists and others sharing concern for the science education of native peoples, and to encourage the participation of Indian professionals in the participation of national scientific societies. AAAS has proposed in its current three-year plan, that its Project on Native Americans in Science serve this clearinghouse function, as well as convening, advisory and advocacy functions which would further action on the recommendations below.

2) A consortium of persons in professional associations, federal agencies and programs that have interests and activities bearing on Indian science education and manpower development should be established. Through their sharing of information and contacts, they could achieve program cooperation and coordination which would enhance their collection effort. Examples of potential participants include persons from American Association for the Advancement of Science, National Academy Committee on Minorities in Engineering, National Science Foundation, National Institutes of Health, American Chemical Society, and American Association of Junior and Community Colleges.

3) A funding guidelines review should be undertaken by private foundations and federal funding agencies to determine priorities and needs for native science education and manpower development and to examine the applicability of present guidelines to Native American programs and needs. Funding organizations and agencies such as the Fund for the Improvement of Post-Secondary Education, National Institutes of Health, National Science Foundation, Energy Research and Development Administration, as well as private foundations with minority programs should be involved in such a review.

4) Coordinated efforts should be established among existing Indian professional associations for program development and advocacy at the regional, state and national level in the areas of manpower development and evaluation of priorities. Closer examination among them could lead to higher levels of information, a more efficient pooling of their energies, and greater impact on policy and programs. Examples of the organizations that could profitably work closely are American Indian Nurses Association, Association of American Indian Physicians, Society for the Advancement of Chicanos and Native Americans in Science and Engineering, National Society of American Indian Engineers, Council of Indian Architects and Engineers.

5) Non-institutionally based programs or satellite programs, should be established to reach populations not ordinarily served by educational institutions. For instance, rural adult science education and literacy programs might be developed by the Department of Agriculture Extension Programs.

## NOTES

[1]See the exploratory study The Barriers Obstructing the Entry of American Indian Students Into the Natural Sciences (hereafter referred to as The Barriers...) by Rayna Green, American Association for the Advancement of Science (AAAS), 1976. Recent data (1976) from the Bureau of Indian Affairs suggest that the enrollment is shifting away from education to other fields, but no major trend can yet be observed.

[2]Data on Native American students collected for The Barriers... study at the Universities of New Mexico, Oklahoma, California (Berkeley), Washington, Southeastern Oklahoma State University, Northeastern Oklahoma A & M (Miami), Bacone College (Muskogee, Oklahoma), and Dartmouth College.

[3]Shirley Mahaley Malcom, John Cownie, Janet Welsh Brown, An Inventory of Programs in Science for Minority Students, 1960-1975, (hereafter referred to as the Inventory...) AAAS Publication 76-R-10, 1976. The programs designed especially for Native American students and other, which may include Indians, have been excerpted and are available separately from the AAAS Project on Native Americans in Science under the title An Inventory of Projects and Programs in Science for American Indians.

[4]Membership lists and identification programs of various Indian professional organizations. A list of the organizations is available from the AAAS Project on Native Americans in Science.

[5]For instance, of the known Indian PhD's in the sciences (20), roughly half are based in educational institutions.

[6]Goals of the Office of Opportunities in Science, Committee on Opportunities in Science, AAAS, 1974.

[7]A Resolution on Native American Contributions to Science, Medicine and Engineering, AAAS Council and Board, January 1975; Janet Welsh Brown, "Native American Contributions to Science, Engineering and Medicine," Science, v. 189 (4 July 1975): 38-40.

[8]See Sheila Tobias, "Math Anxiety: What Is It and What Can Be Done About It?" MS Magazine (September 1976).

[9]Carl Hime, Culture Related Instructional Materials: Ethnoscience, A Brief History and Progress Report (1972); Concepts, Observations on Ethnoscience and Cultural Studies (1974), MSS, Many Farms High School, Arizona.

[10]Minorities in Science Symposia Proceedings, AAAS Annual Meeting, Boston, 1976. (In preparation); The Double Bind: The Price of Being a Minority Woman in Science, AAAS Report 76-R-3, 1976.